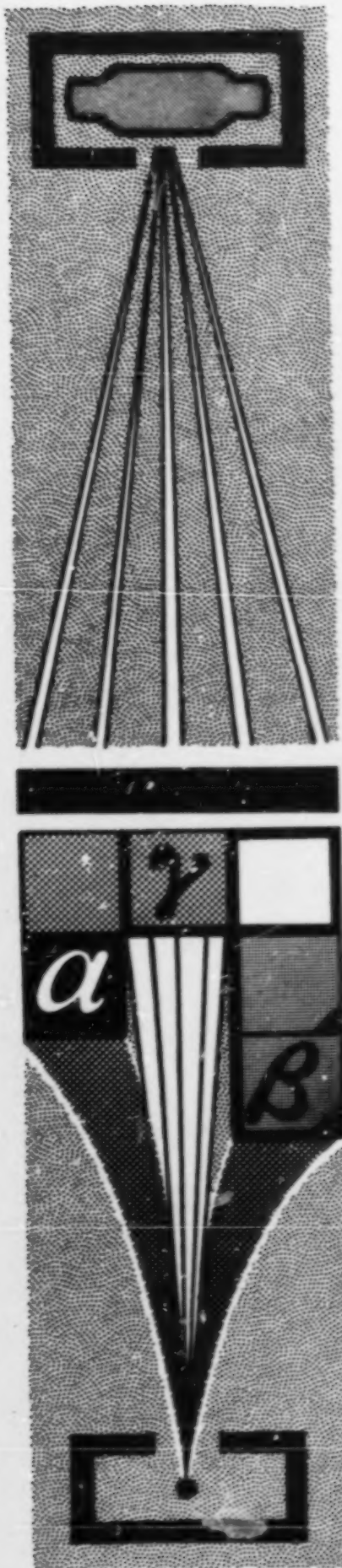


BRH/DMRE 71-3

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STORAGE and HANDLING DEVICES for RADIUM



A

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STORAGE and HANDLING DEVICES for RADIUM

Radioactive Materials Investigation Section
Division of Medical Radiation Exposure

P.O. Box 61
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JUNE 1971

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Bureau of Radiological Health
Rockville, Maryland 20852

FOREWORD

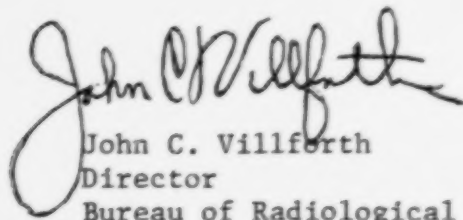
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I encourage the readers of these publications to inform the Bureau of any omissions or errors. Your additional comments or requests for further information are also solicited.



John C. Villforth
Director
Bureau of Radiological Health

PREFACE

This work reported herein was performed at the Southeastern Radiological Health Laboratory (SERHL) of the Bureau of Radiological Health in Montgomery, Alabama. In December 1970, the SERHL was transferred to the Environmental Protection Agency. The radioactive materials investigation project, primarily concerned with radium and its daughter products, continues to be a Bureau of Radiological Health responsibility located at SERHL.

Difficulties encountered during radium storage and research operations have resulted in the development of many new and improved handling techniques for radium-226 sources. These innovations include several devices and methods that reduce personnel exposure during handling and storage of radioactive materials. This report describes some of these techniques for the benefit of others who might encounter similar problems.



Charles R. Porter
Director
Southeastern Radiological
Health Laboratory



Arve H. Dahl
Acting Director
Division of Medical Radiation
Exposure

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STORAGE AND HANDLING DEVICES FOR RADIUM

INTRODUCTION

The Radioactive Materials Investigation Section is located at the Southeastern Radiological Health Laboratory in Montgomery, Alabama, and has been engaged in storage and research operations with a variety of radium-226 sources.

Nearly 1100 sources containing a total of more than 50 grams of radium have been sent to the laboratory, primarily by industrial and medical organizations. Nearly all these sources are damaged, are contaminated, and/or leak radium and radon. In the course of investigative studies at the laboratory, using some of these sources, several useful storage, handling, and research techniques were developed.

FACILITY FOR STORAGE OF RADIOACTIVE MATERIALS

To safely handle and house the radium sources shipped to the laboratory, storage and handling techniques were developed on the basis of specific needs and existing facilities. Two storage areas were designed and built, one for medical-type radium sources and the other for radium-beryllium neutron sources.

The medical radium storage facility (figure 1) consists of a pit 12 feet long by 2-1/2 feet wide by 8 feet deep, lined with concrete containing a layer of lead; hinged steel doors with locks cover the top. The pit is housed in a wood-frame structure that is ventilated by exhausting air through fiber glass and charcoal filters. A 1000 lb. capacity chain hoist travels on a rail about 4 feet above the top of the pit. Twelve permanent lead shields having a minimum wall thickness of 2 inches are embedded in the concrete floor at the right-hand end of the pit. These shields with removable lead plugs 8 inches long have a cylindrical storage volume 3 inches in diameter and 7 inches in length. The remaining area of the pit floor contains over 20 movable storage shields for sources which may be frequently transferred between storage and laboratory. Each shield, weighing a maximum of about 300 lbs., is capable of safely handling up to approximately 300 mg of radium-226.

The neutron source storage facility (figure 2) was designed for long-term storage of radium-beryllium neutron sources. Since the physical size of this type of source is more difficult to predict than that of the medical type, a larger storage volume for the sources was necessary in the design of this facility. For this purpose 26 steel casings, each 10 feet long, were vertically embedded in the concrete foundation of a building specifically designed and located for long-term storage of high-level radium-beryllium sources. Of the 26 wells, 10 have inside diameters of 12 inches and the remaining have diameters of 8 inches. Each storage well

is sealed at the bottom by a steel plate and is capped at the top by a snug-fitting 3-foot-thick removable concrete plug. In addition to the 26 wells there are two 4-foot-square pits, 10 feet deep, to accommodate bulky sources. On two facing sides of the storage area are 2-foot-thick concrete biological shields, 5 feet high and 8 feet long. Three large adjustable mirrors hang from the ceiling over the storage area and provide a comprehensive field of view for personnel behind the concrete shields. A chain hoist on movable rails is used to move the concrete plugs, portable shields, shipping containers and other heavy items in the storage area. The area between the shields is approximately 20 feet long by 12 feet wide, with access to the outside through double doors to an adjoining concrete loading platform.

HANDLING HARDWARE

Radium sources sent to the laboratory for storage are usually shipped in screw-cap steel inner containers that fit into lead-shielded shipping crates. On arrival at the storage facility, the sources are removed from the containers and placed into a storage shield. Most of these screw-cap containers have a hole in the cap into which a pin may be inserted to facilitate removal of the cap (figure 3). Use of conventional wrenches and tools for cap removal involves unnecessary handling and radiation exposure to personnel. Development of a long-handled wrench to hold the container and a slotted "T" wrench to clasp the pin enable the operation to be performed at a safe distance. A shielded vise effective for handling screw-cap containers was also developed. These tools and their uses are shown in figures 4, 5, and 6.

Although the screw-capped container is necessary for shipping radium sources which leak radon, its use is not essential in storage facilities. Consequently, a container was designed and built for storage purposes only, which can be quickly sealed or unsealed for loading radium sources and yet maintains a tight seal for radon containment (figure 7). It employs a copper pipe about 3-1/2 inches long and 1/2-inch internal diameter; one end is sealed by a soldered closure. The removable closure for the other end consists of an expanding-plug soft drink bottle cap, modified by replacing the rubber sleeve with an equal length of tygon tubing packed with silicone stopcock grease. This container fits the removable shields used in the radium storage pit and can be opened or sealed in a few seconds, using long-handled tongs. Experiments in which more than 100 mg of leaking radium sources were stored in a quick-open container within a shield showed essentially no radioactive leakage. The interior surface of the snap-on cap exposed to the sources registered over 2,000,000 alpha cpm, as measured by an alpha survey meter.

Magnetic retriever devices were developed at the laboratory for safe handling of sources in storage (figure 8). For our specific needs, the retrievers were made in both long and short configurations. The long unit permits safe handling of small containers and some sources while they remain at the bottom of the shielded radium storage well. The short unit enables removal of steel and quick-open copper containers from their lead shields with minimal radiation exposure to the handler.

Commercially-available tongs were modified for more efficient handling of small sources. The improvement (figure 9) consists of squaring and grooving the jaws of the device. The grooves prevent the jaws from ejecting sources and also permit positive handling of small cells and needle sources.

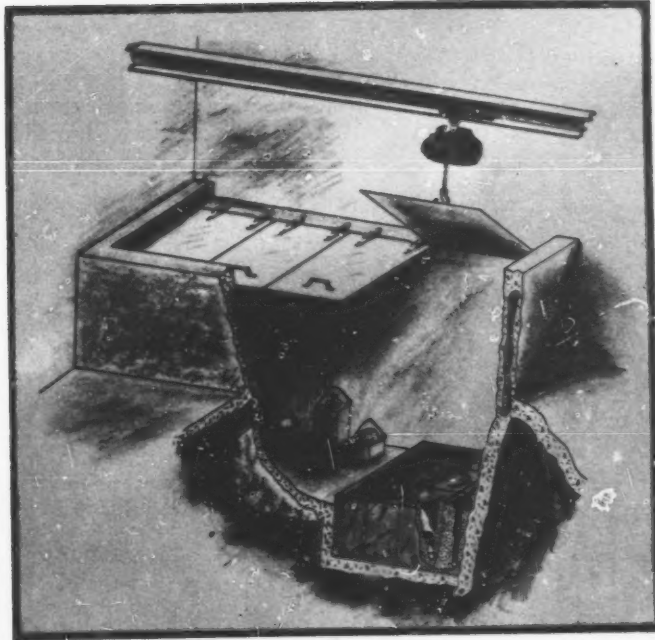


Figure 1. Medical radium storage facility. Pit lined with lead and concrete contains lead shields sunk into concrete (R.) for "permanent" storage and portable shields (L.) for temporary storage.

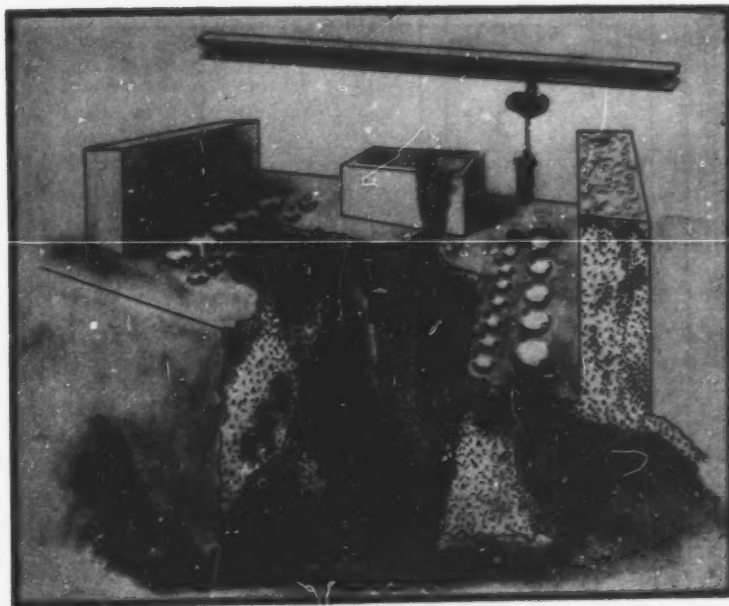


Figure 2. Neutron source storage facility, containing 26 steel-lined wells and two concrete pits.

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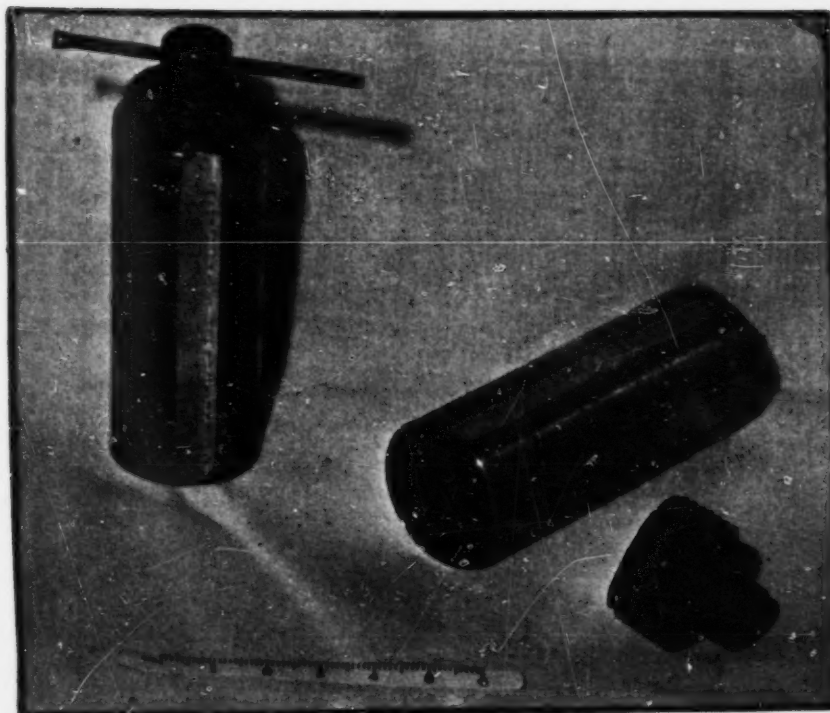


Figure 3. Screw-cap container for storage of radium sources. Cap is removed by unscrewing it with the aid of a pin.

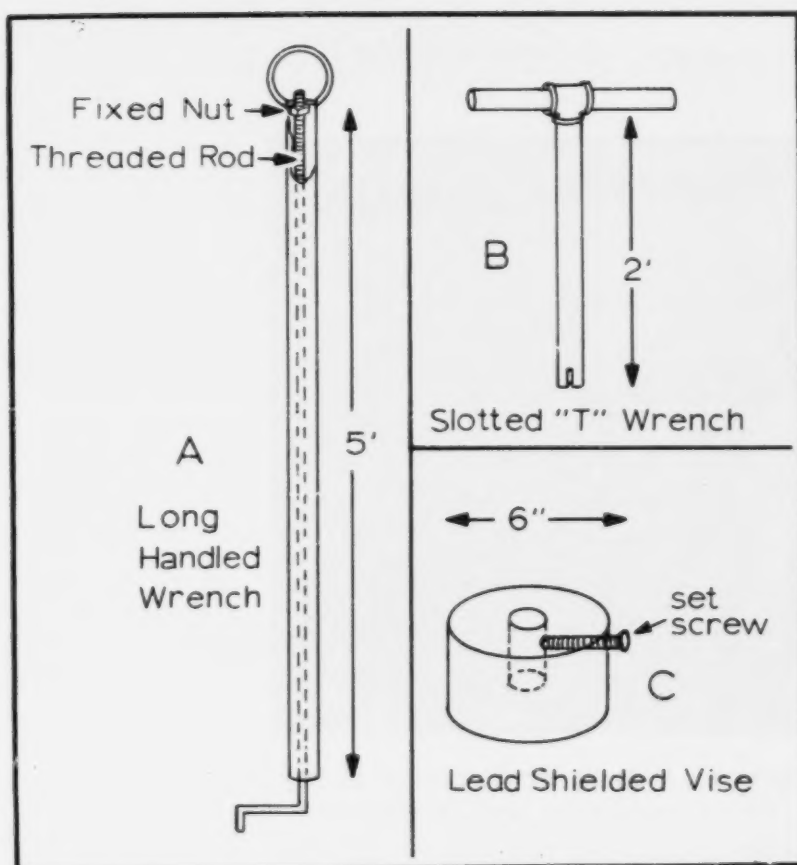


Figure 4. Tools fabricated for handling radium source containers.



Figure 5. Use of long-handled wrench permits containers of radioactive materials to be handled safely at remote distances.



Figure 6. Slotted wrench provides safe positive means of removing screw cap from container held by long-handled wrench. Shielded vise safely holds another container bearing radioactive sources.



Figure 7. Copper tube and snap-on cap. This assembly (L.) can be used to replace conventional container (R. and figure 3) for storage of sources only.

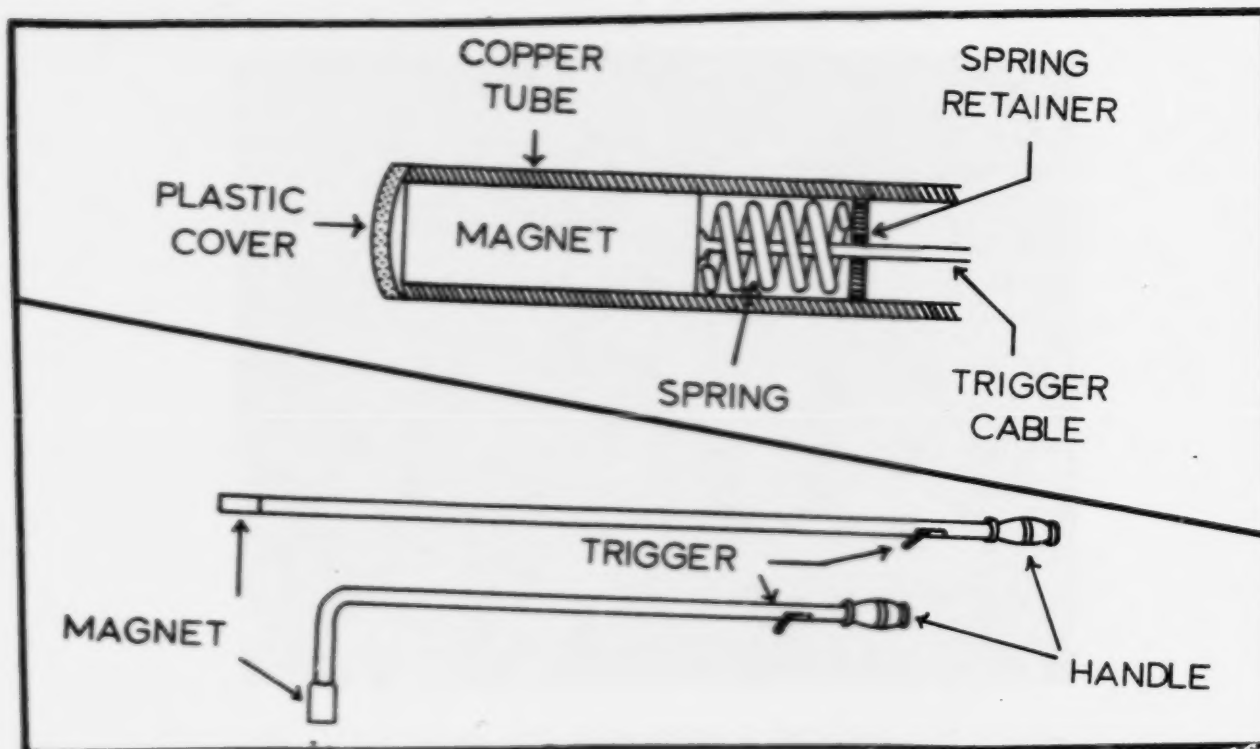


Figure 8. Magnetic retriever devices for safe handling of sources in storage. Source containers are released by pulling trigger to retract magnet (see detail).

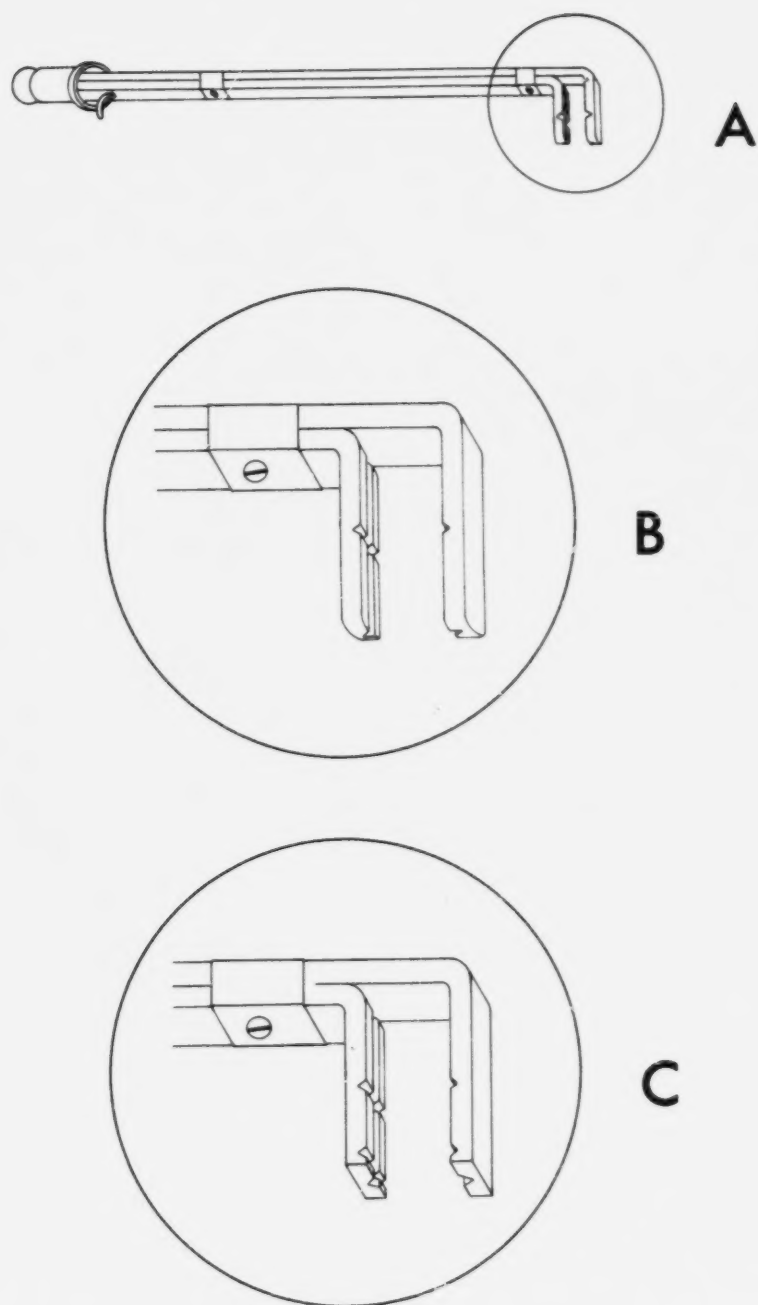


Figure 9. Modification of commercially-available tongs (A) to facilitate handling of small sources. Jaws (B) are squared at ends and additional notches are filed (C).

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